

A Systematic Review Comparing Biologic vs Synthetic Meshes in Implant-Based Breast Reconstruction

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Introduction

Breast cancer is the most common malignancy in women globally.¹ Implant-based breast reconstruction (IBBR) is currently the most popular type of postmastectomy breast reconstruction,² and recently the use of surgical mesh in IBBR has become commonplace.³

Surgical meshes are divided into two broad categories: biologics and synthetics. Biologic meshes are made of human or animal tissues that have been stripped of their antigenic properties and processed into matrices of collagen and elastin.⁴ Synthetic meshes are made of manufactured polymers that can be knitted or woven, absorbable or non-absorbable, and are generally available at a much lower cost than biologic matrices.⁵ Within each mesh category there are many products currently on the market, each with their own reported advantages and disadvantages.

Though there is a long-standing belief that biologic mesh is superior to synthetic mesh in terms of surgical complications and patient outcomes, few studies exist to support this claim. This systematic review evaluates all published studies comparing biologic and synthetic meshes in IBBR, to determine which category of mesh produces the most favorable outcomes.

Methods

Search Strategy and Study Inclusion Criteria:

A systematic search of the Embase, PubMed, and Cochrane databases was performed in January 2022 according to PRISMA guidelines. Primary literature studies investigating clinical outcomes of IBBR performed with synthetic and biologic surgical mesh after oncologic or prophylactic mastectomy were considered. Only studies comparing biologic and synthetic meshes within the same experimental framework were included. Papers were excluded if they were based on case studies, animal models, or in vitro experimentation. Two independent reviewers repeated the screening process.

Study Assessment and Data Extraction:

Outcomes of interest covered a range of surgical complications typically associated with breast reconstruction. In several papers, longitudinal and subjective outcomes were also collected. For each included article, information regarding the study design, types of mesh used, patient metrics, and outcomes or complication rates was extracted. In all cases, a P value of < 0.05 was considered statistically significant. Study quality and bias was assessed using the validated Methodological Index for Non-Randomized Studies (MINORS) criteria.⁶ MINORS scores were determined separately by 2 independent reviewers, and the average score was reported.

Results

Figure 1: PRISMA Flow Chart

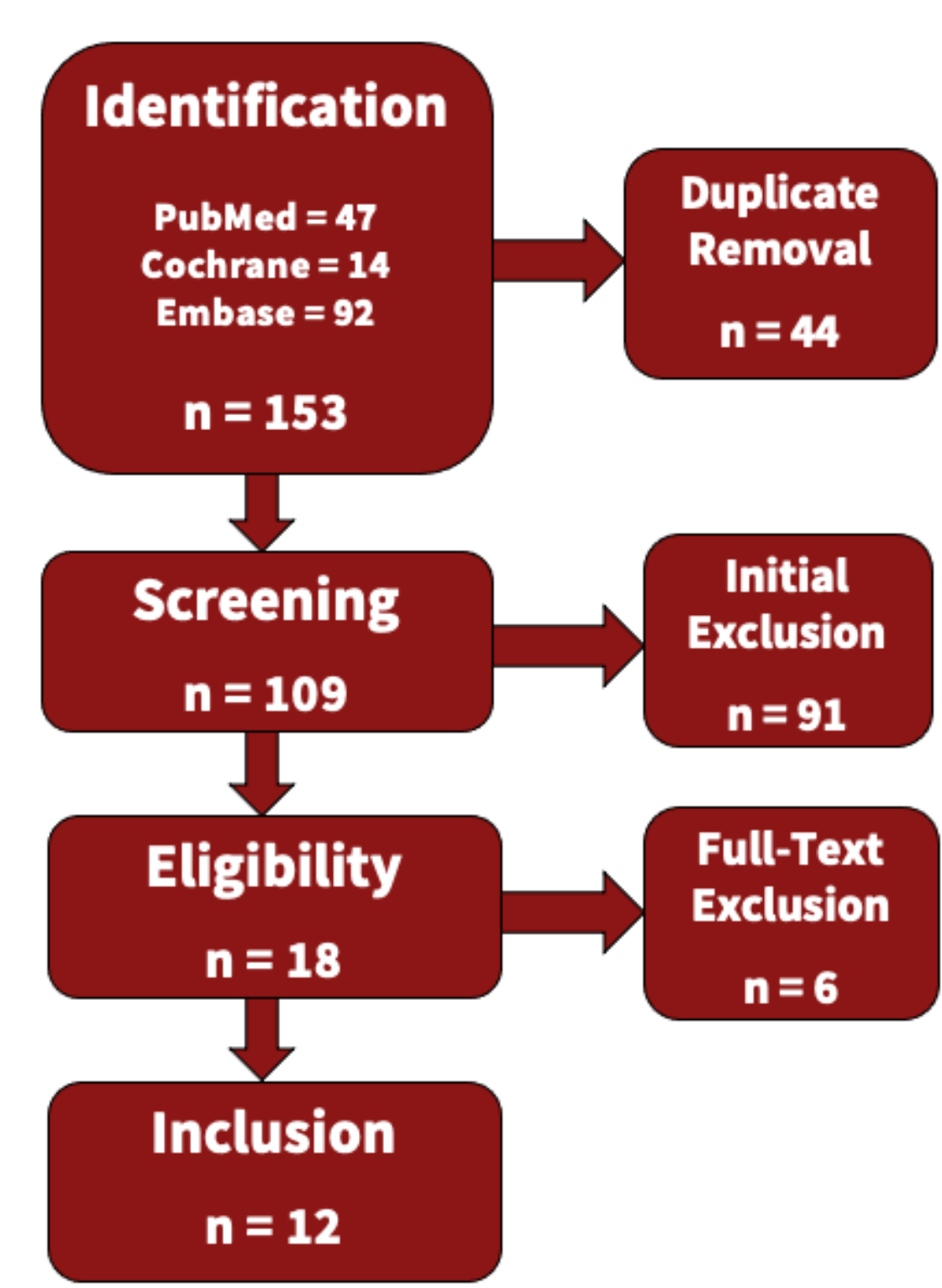


Table 1: Summary of Included Studies

STUDY AUTHOR AND YEAR	SAMPLE SIZE	MAJOR FINDINGS	% OF IDEAL MINORS SCORE
Reitsamer et al. 2019 ⁷	134 patients, 200 breasts	No differences in complication rates or cosmetic results identified between the mesh groups. However, comparing biologic and synthetic meshes was only a secondary study aim.	59%
Hansson et al. 2021 ⁸	24 patients, 48 breasts	Higher incidence of seroma, secondary infection, and implant loss seen with biological meshes compared to synthetic meshes.	85%
Hansson et al. 2020 ⁹	15 patients, 30 breasts	Significant differences in the type of histologic reaction to each mesh type were observed in the capsular samples collected during stage 2 surgery. More foreign body reaction and giant cells could be seen in the synthetic meshes. Biologic mesh showed deeper fibrosis and more neovascularization. No difference in capsular contracture was observed at follow-up.	90%
Hansson et al. 2020 ¹⁰	12 patients, 24 breasts	Total drain production and daily drain production were similar between mesh groups in the post-op period. After drain removal, there were more seroma aspirations in the biological group. During stage 2 surgery, there was a higher incidence of seroma >1dL in the biological group.	88%
Hallberg et al. 2019 ¹¹	94 patients surveyed	The synthetic group had fewer overall complications and a lower rate of implant loss. When the analysis was adjusted for complications, there was significantly lower satisfaction with reconstructive outcome in the biological group. Capsular contracture rates were similar between the groups.	48%
Gschwantler-Kaulich et al. 2017 ¹²	48 patients, 48 breasts	Higher incidence of severe complications, failed reconstructions, and implant loss in the biologic group. Differences in QoL measures all favored synthetic over biologic meshes. Patient ratings of cosmetic outcome did not differ between groups, but independent specialists graded synthetic meshes significantly higher than biologic meshes for aesthetic outcomes.	83%
Sewart et al. 2021 ¹³	879 patients surveyed	No differences in complication rates or cosmetic results were identified between the mesh groups. However, comparing biologic and synthetic meshes was only a secondary study aim.	73%
Potter et al. 2019 ¹⁴	1376 patients	No differences in complication rates or cosmetic results identified between the mesh groups. Biologic mesh was the most popular reconstructive material used. Patient factors such as increased BMI, current smoking status, and operative time were associated with an increased risk of complications.	90%
Schüler et al. 2021 ¹⁵	157 patients, 188 breasts	Synthetic mesh had lower overall complications and reconstructive failure rates compared to biologic mesh. Preoperative radiation therapy was significantly correlated with seroma, wound healing disorders, wound infections, and implant losses in all meshes studied. Post-operative radiation therapy was not significantly related to reconstruction failure.	58%
Quah et al. 2019 ¹⁶	150 patients, 216 breasts	The biologic mesh group had higher rates of seroma, mesh non-integration, implant rotation, infection, and wound breakdown compared to the synthetic group. The biologic mesh group also had higher rates of minor and major interventions, including reoperation and implant loss.	73%
Ohlinger et al. 2021 ¹⁷	121 patients surveyed	Mes type was not associated with significant differences in any of the BreastQ survey domains. Patients who received radiation therapy had significantly lower satisfaction with their outcome.	48%
Ohlinger et al. 2021 ¹⁸	281 patients, 362 breasts	The rates of major and minor complications were higher in biologic mesh group. In the Stratrice group (biologic), radiation increased the rates of seroma, infection, and implant loss. In the Seragyn group (synthetic), there was no effect of radiation on outcomes. In the TILoop group (synthetic), radiation increased the rates of infection and implant loss.	50%

Figure 2: Summary of Study Findings Comparing Surgical Complication Rates Between Mesh Types

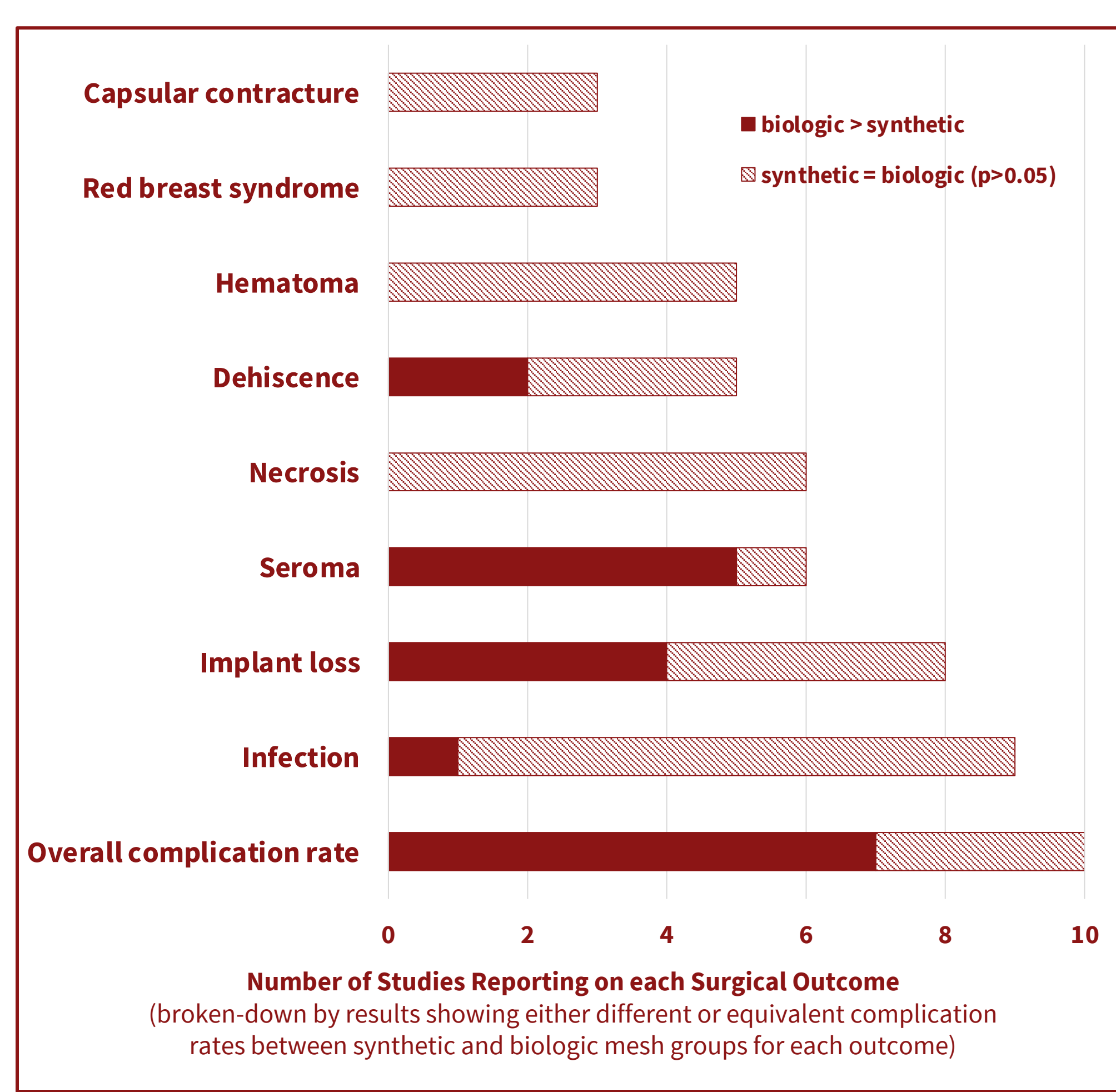
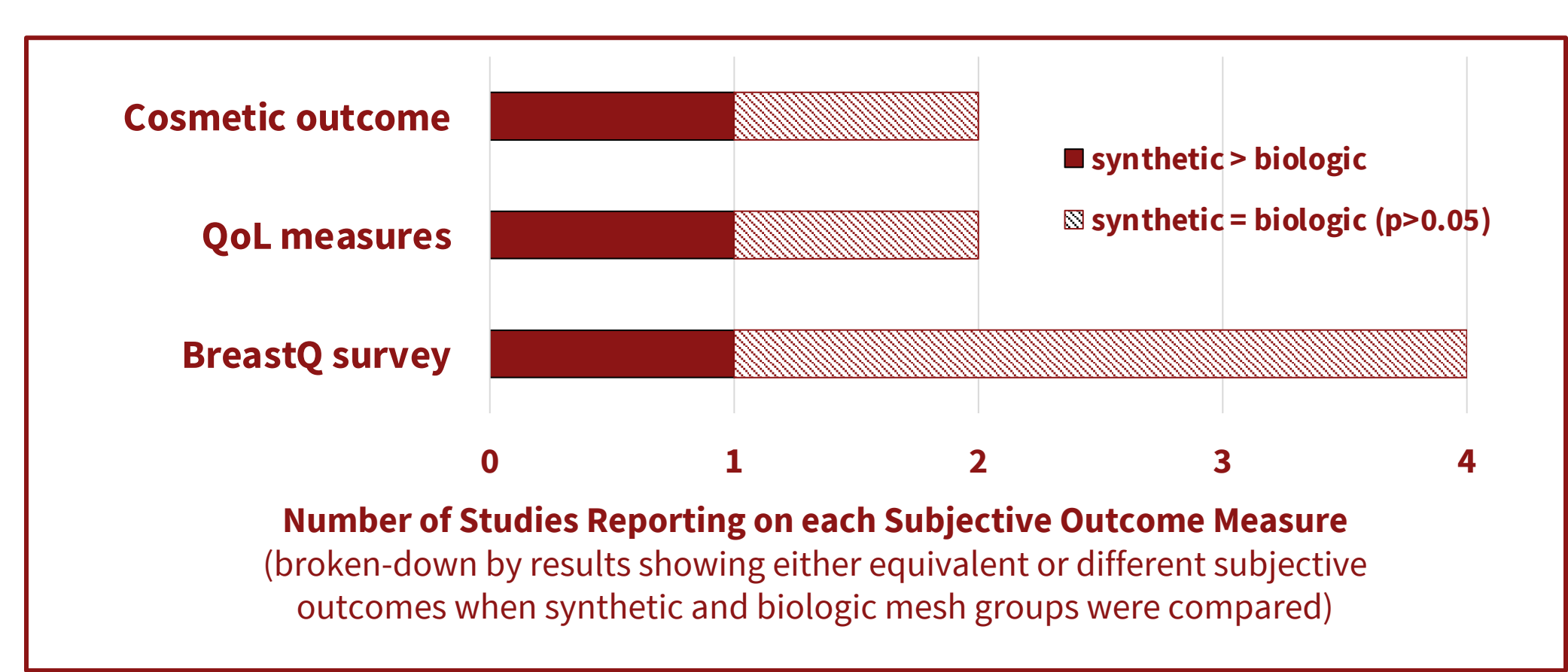


Figure 3: Summary of Study Findings Comparing Subjective Outcomes Between Mesh Types



Key Take-Aways:

- Twelve publications met inclusion criteria, covering a range of study methodologies and outcome measures.
- In all 12 studies, synthetic meshes produced either equivalent or lower complication rates vs biologic meshes for every outcome reported.
- All studies assessing subjective outcomes reported that synthetic meshes were equivalent or superior to biologic meshes for all reported measures.
- Non-randomized studies were often limited by a lack of baseline equivalence between study groups, potentially biasing results.
- On average, the studies included in this review tended to have moderate quality and bias scores.
- The mean MINORS score was 70.4% of an ideal (perfect) score.

Conclusions

This systematic review is the first comprehensive evaluation of all published studies comparing biologic and synthetic meshes in IBBR. The consistent finding that synthetic meshes are at least equivalent to biologic meshes across a range of outcomes offers a compelling argument in favor of using synthetic meshes in IBBR. With their substantially lower price point, wider availability, and higher degree of flexibility in terms of functionality/ device parameters, synthetic meshes appear to be a high-quality alternative to biologic meshes for use in IBBR.

Future Directions

Several studies in this systematic review faced limitations that may have impacted the quality of their results. Future studies should operate under the assumption that synthetic and biologic meshes are equivalent and design more robust randomized trials comparing these devices. Given that lower costs are an appealing aspect of synthetic meshes, future studies should include cost analyses in their assessment of different meshes. Though meshes can be broadly categorized as synthetic or biologic, each mesh group is made up of a heterogeneous mix of products with their own strengths and limitations. Additional studies will be needed to evaluate the outcome profiles associated with each unique interposition device used in IBBR.

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